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ABSTRACT

The purpose of this research project was to develop techniques for analyzing user searches of the Syracuse University Libraries Information Retrieval Systems (SULIRS) to enable library staff to identify and test potentially high payoff modifications to the system and/or to user documentation. The first task was an exploratory analysis of recorded user searches to identify the patterns that occur most often. The outcome was a model of user interactions, frequency data, and guidelines for designing an automatic analyzer of recorded searches. The second task was to develop the automatic analyzer, which is now able to summarize the frequency of use of various search codes and the average number of search terms used. It is also able to separate library staff use, library patron use, and external library use. The final task was to vary the versions of user documentation at terminals to determine whether changes in assistance lessened the occurrence of problems. Modifications based on the findings of this study will be introduced into SULIRS, and it is expected that the automatic analyzer will be used to determine how user behavior changes in response to system modifications. Sample printouts from the transaction log are appended. (BBM)

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FEEDBACK AND EXPLORATORY MECHANISMS FOR ASSISTING LIBRARY STAFF IMPROVE ON-LINE CATALOG SEARCHING

June 1983

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SUMMARY

The purpose of the research project was to develop techniques for analyzing user searches of the Syracuse University Libraries Information Retrieval System (SULIRS) so that the library staff could identify and test potentially high payoff modifications to the system and/or to user documentation. Machine-readable recordings of user searches were examined by the research assistant, initially by hand and later by computer program. These records are called the transaction log in this report.

Three tasks were identified for completion during the project:

- The first task was an exploratory analysis of recorded user searches in order to determine what patterns occur most often. The outcome was a model of user interaction, frequency data, and guidelines for designing an automatic analyzer of recorded searches.

- The second task was to develop the automatic analyzer, which is now able to summarize the frequency of use of various search codes and the average number of search terms per code. It is able to separate out library staff use, library patron use, and external library use.

- The final task was to vary the versions of user documentation at terminals in order to determine whether or not changes in assistance lessened occurence of problems. It was found that very few users look at documentation, and so the library has stationed staff members near the terminals to give personal assistance in searching.

During the coming months modifications will be introduced into SULIRS that have benefitted from this research project. It is expected that, as new changes are introduced, the automatic analyzer will be used to determine how user behavior has changed.

SULIRS

For many years Syracuse University has been involved in automating library functions. SULIRS, the online public access catalog, is one aspect of this library automation. Nineteen terminals are available throughout the main library and branches for patrons to use for retrieving catalog information and availability information for books and periodicals. (Thirteen terminals are available for staff use with SULIRS, plus others for circulation, etc.) Appendix D contains the SULIRS Users' Guide, which explains how to access information from the on-line catalog.

SULIRS was recently made accessible via any terminal on campus. Approximately 390 terminals, plus many dial-ups, can now access SULIRS from library locations, private offices, and public terminal clusters. Forty eight terminals can be handled simultaneously.

There are a number of search codes that a patron might employ to access records, but the most heavily used codes are AU, TI, SB, and WD. (These are: AUthor, TItle, SuBject, and WorD, the latter meaning words from either title or subject). Most searches are of the form "WD; WOMEN RELIGION", where a search code is followed by one or two search terms. A search of this form accesses all catalog records having both the word "WOMEN" and the word "RELIGION" in their title or subject fields. The user is told how many items were retrieved and how to display them. For example, the above search retrieved 42 records, including Jefferson Fletcher's The Religion of Beauty in Women and Elizabeth Clark's Women and Religion: A Feminist Sourcebook of Christian Thought. This final work was the ninth displayed, and was apparently what the searcher was interested in, for displaying of catalog records ceased at this point. A sample of the sorted transaction log, including this search, is in Appendix B.

There are a number of benefits and limitations to the existing SULIRS transaction log. The major benefit is that this log is quite complete, since it contains both the user search request and the complete response from the computer. All text displayed on the screen is recorded in the log, with a date-time stamp and a terminal port number on each line of text. Secondly, the SULIRS system staff uses this log to help diagnose system problems. Since the log records all activity, it contains the last action taken when the problem occurred. The final benefit concerns sorting the transaction log. In its raw unsorted form, the transaction log is too complicated to be easily used by hand. Transactions are recorded in strict time sequence, with transactions from different terminals intermixed. However when the log is sorted by terminal port number and date-time, the log is much easier to use and is very rich in detail. One can then get a qualitative idea of what is being done by the user. For example, one can see in the log where a user types in "TI; EDUCATION", gets 999 items back, and then does not really know what to do.

The limitations of this log revolve around some difficulties in using it. First, it is not possible to determine when one search logically ends and another begins. Secondly, it is not possible to determine whether or not a user has found anything of value during the search, i.e., there is no way to express satisfaction or frustration. Thirdly, since the log is so complete, it is voluminous and is difficult to use in a manual scan.

EXPLORATORY ANALYSIS OF THE LOG

The first stage of the study was to qualitatively go through many days worth of the transaction log in order to get some feeling for how patrons were using SULIRS. Four hundred and thirty separate searches, composed of a search code followed by one or more terms, were examined by the research assistant. A number of things became clear.

1. Many people tend to type in a complete title or subject when they do a search. Users seem to be unaware of the fact that SULIRS "ands" together all of the terms, often resulting in a message NO ITEMS FOUND.

2. Users seem to be unaware of the fact that when they use the SB code, SULIRS will search for words from the Library of Congress subject headings. Uses do not realize that the restricted vocabulary words they use in SB requests should be different from the words they use in other requests.

3. Users tend to type only one, or at most two keywords when they use the WD code. This often results in retrieving a very large number of items, which are seldom completely browsed through. From this it can be deduced that users are not aware that searching by WD is equivalent to searching in the combined title and subject fields.

4. Users rarely appear to realize that they could combine author and subject/title searches, or that they could start with a broad search and refine it in subsequent iterations with the AND command.

5. Most searchers continue to use the same search code from search to search. Reformulation of a search is generally done by changing the key words used, not by trying different search codes.

6. Lost or confused users do not seem to be aware of the HELP program which explains search procedures in detail. Users normally quit after getting the message-- "MISSING/BAD SEARCH CODE."

A rough tally of the search codes used, and whether they led to an apparently successful search, appears below. A successful search is defined to be: 1) one where at least one item is found, and 2) one where a large number of items are found and this list is at least partially scanned by the user.

Search Code	Number of Uses	% of Successful Searches
WD	122	36
SB	100	26
AU	63	16
TI	62	22
	347	100%

(Search codes were missing or entered incorrectly for another 83 searches.)

It is very hard at this time to draw more than impressionistic conclusions from this data. One thing that appear when the data for library staff and patrons are separated is that the library staff tend to use AU and TI heavily, with very little use of the other two codes, while patrons tend to use author about half the time and any one of the other three codes the rest of the time.

AUTOMATIC ANALYSIS

From the exploratory analysis of the transaction log, a number of decisions were made as to what types of data might best be extracted from it. One decision was to separate usage by library staff from public usage. Now that SULIRS is available campus-wide, a third category of use is by users outside the library. If there are major differences in library staff usage and public usage, it then may be worthwhile to find out what the staff has learned and make sure it is communicated to users.

A second decision was to get simple usage statistics for each terminal. From that it will be possible to calculate how rapidly usage is growing, and where new ports are needed. We have defined "a use of SULIRS" to be the typing of a valid search code, followed by one or more search terms.

A third decision was to keep track of the usage of each search code and the average number of search terms used with the code. For example, it appears in early use of the automatic analyzer that TI searches tend to involve more terms than any others. It was hoped that the analyzer could keep track of the number of items found as a function of the number of search terms. This turns out to be somewhat difficult to do in cases where search requests combine author and subject codes, or where a request is later modified using the AND command. In the future, a facility will be included in the analyzer to keep track of the relationship between search terms and items retrieved. A sample of the analyzer

output is included in Appendix A. Because the output is easy to read, it is likely that the analyzer will be run from time to time to measure usage data.

There are also difficulties with the analyzer. It has been written in interactive PASCAL by the research assistant, while SULIRS is written in PL/I. Consequently, the two systems are unlikely to be revised and/or maintained by the same person. Every time SULIRS is modified, the analyzer must be modified. Secondly, the analyzer is set to run interactively, whereas a production-oriented analyzer could be run either interactively, or in batch with no staff intervention. Ideally an automatic analyzer should be programmed as an integral part of the retrieval system. A future task for SULIRS' developers could be to use this PASCAL version as a template in a conversion to PL/I and inclusion of it in the on-going production activities of SULIRS. (Appendix C contains a listing of the PASCAL program which does this SULIRS transaction log analysis).

FUTURE PLANS

It turned out to take much longer to get the automatic analyzer running than anyone had intended. Consequently, it has not been possible to gather data on changes in user behavior. By the end of a school year, most students and staff have learned most of what they need about searching. In the present case, library staff are readily available to help users with their problems. Perhaps in the fall when there are many confused new library users, usage might be monitored to check for patrons having difficulty.

The library and the SULIRS system staff have already developed a list of SULIRS modifications for introduction in the coming year. Many sources have contributed to the list. The CLR-sponsored study of user reactions to online public access catalogs (Markey, 1983) led to many good suggestions for improvement, as did the report (Markey, 1982). A Syracuse-sponsored research project on how to use subject headings to stimulate searching breadth has also had an impact.

The current project has also contributed in pointing out the confusion between different search codes, and the difficuties users have when they run into trouble. It has been suggested that there be at least two different interfaces, one for beginners and one for skilled users. It has been pointed out that users need to be told to enter fewer terms or to check spelling when they get zero results. Users also need to be reminded that they can use the AND command when their initial search retrieves too many items. Two possible modifications resulting from this study are to try to find a way to get users to indicate when they have found something useful, and to get users to indicate when they are starting (or finishing) a session with SULIRS. Perhaps the way that satisfaction can be elicited is to make it possible for users to print out useful items so they can take the list with them to the stacks.

CONCLUSION

The project is hopefully just the beginning of a long term relationship between the SULIRS staff, and researchers in the School of Information Studies. The intention was to develop a tool which would provide library staff with feedback about SULIRS usage. In six months it is hard to accomplish all that one would hope. A simple automatic analyzer now exists and is likely to be extended in the future. Both the library staff and the information studies personnel feel that progress has been made. The long range goal of using feedback to assist in system redesign will help to motivate both sides to work together in the future. In the long run, library patrons will benefit as they increase their productivity and satisfaction while searching.

REFERENCES:

1. Markey, Karen, The Process of Subject Searching in the Library Catalog: Final Report of the Subject Access Research Project, Dublin, OH, OCLC, 1983, 137 p.

2. Hildreth, Charles R., Online Public Access Catalogs: The User Interface, Dublin, OH, OCLC, 1982, 263 p.

Appendix A: Automatic Analyser Output

```
PROGRAM TITLE: AUTOMATIC ANALYSER FOR SULIRS TRANSACTIONS
               LOG.
PROGRAMMER: KUMUD MADHOK
DATE: MAY 3, 1983
PURPOSE: FOR CLR GRANT "FEEDBACK AND EXPLORATORY MECHANISMS
         FOR ASSISTING LIBRARY STAFF IMPROVE ON-LINE CATALOG
         SEARCHING"


TYPE INPUT FILE NAME
.dataset


HOW MANY RECORDS TO SKIP? TYPE ONLY NUMBERS
.0

HOW MANY RECORDS TO PROCESS? TYPE ONLY NUMBERS
.100000


TYPE IN DESIRED OPTION NUMBER
YOU HAVE 3 OPTIONS:   1)LBSTAFF
                      2)LBPUBLIC
                      3)EXTERNAL
.1
          500TH RECORD READ
         1000TH RECORD READ
         1500TH RECORD READ
         2000TH RECORD READ
         2500TH RECORD READ
         3000TH RECORD READ
         3500TH RECORD READ
         4000TH RECORD READ
         4500TH RECORD READ
         5000TH RECORD READ
         5500TH RECORD READ
         6000TH RECORD READ
         6500TH RECORD READ
         7000TH RECORD READ
         7500TH RECORD READ
         8000TH RECORD READ
         8500TH RECORD READ
         9000TH RECORD READ
         9500TH RECORD READ
        10000TH RECORD READ
        10500TH RECORD READ
        11000TH RECORD READ
        11500TH RECORD READ
        12000TH RECORD READ
        12500TH RECORD READ
        13000TH RECORD READ
        13500TH RECORD READ
            .
            .
            .
```

SORTED BY PORT NUMBER

PORT NUMBER	USE-FREQUENCY
99	5
107	0
115	0
119	85
124	146
125	0
126	20
142	0
143	8
161	0
190	0
192	0
193	0
194	27
196	116
220	0
240	118
241	160
242	32
243	37
244	0
254	0
259	18
261	44
386	0

SORTED BY FREQUENCY

PORT NUMBER	USE-FREQUENCY
107	0
115	0
125	0
142	0
161	0
190	0
192	0
193	0
220	0
244	0
254	0
386	0
99	5
143	8
259	18
126	20
194	27
242	32
243	37
261	44
119	85
196	116
240	118
124	146
241	160

SEARCH-CODE	USE-FREQ	AVG TERM-NUM
AU	302	1.483
TI	377	1.979
SB	14	1.643
WD	11	1.727
ST	66	2.773
CN	26	1.346
LC	70	1.000
OC	22	1.000
IB	31	1.000
IS	2	1.000
AN	41	1.195

TOTAL NUMBER OF RECORDS IN DATA FILE IS 87746

TIME RANGE IS FROM 09042977 ON 830126 TO 14450559 ON 830126

```
PORT   DATE     TIME          MSG TO/FROM USER

 237   820923   15093647   W  F2001.C25 C.2 :  5TH FLOOR-BIRD
 237   820923   15093824   W
 237   820923   15093975   W
 237   820923   15094662   W
 237   820923   15094761   W    38 ITEMS. PRESS RETURN FOR DISPLAY, OR S AND RETURN FOR NEW SEARCH:
 237   820923   15094995   R
 237   820923   15095063   W
 237   820923   15095085   W    33. AFROLIT SOCIETY LITERACY SEMINAR (4TH :1975 : ADDIS ABABA) *
 237   820923   15095188   W   LANGUAGE AND MEDIA SUPPORTS FOR NON-FORMAL ADULT BASIC EDUCATION : PAPERS,
 237   820923   15095267   W  SPEECHES, AND REPORTS TO THE FOURTH BIENNIAL AFROLIT SOCIETY LITERACY SEMINAR
 237   820923   15095442   W  NAIROBI, THE SOCIETY, C1977
 237   820923   15095471   W  LC45.8.A4A35 1975 ; 4TH FLOOR-BIRD
 237   820923   15095588   W
 237   820923   15095630   W    34. LANGUAGE AND DIALECT ATLAS OF KENYA, VOL. 1: HEINE, BERND, GEOGRAPHICAL
 237   820923   15095706   W  AND HISTORICAL INTRODUCTION LANGUAGE AND SOCIETY
 237   820923   15095774   W   BERLIN, REIMER, 1980
 237   820923   15095799   W  RECEIVED
 237   820923   15095981   W
 237   820923   15100040   W    35. CRANE, ROBERT I *
 237   820923   15100077   W   LANGUAGE AND SOCIETY IN MODERN INDIA, ESSAYS IN HONOUR OF PROFESSOR ROBERT O.
 237   820923   15100161   W  SWAN ; COLOMBIA, MO, SO. ASIA BKS, 1981
 237   820923   15100209   W  UNCATALOGED ; 5TH FLOOR-BIRD
 237   820923   15100326   W
 237   820923   15100345   W    36. BLOUNT, BEN G., 1940-
 237   820923   15100377   W  LANGUAGE, CULTURE, AND SOCIETY: A BOOK OF READINGS
 237   820923   15100827   W  CAMBRIDGE, MASS, WINTHROP PUBLISHERS, 1974
 237   820923   15100953   W  P41.B48 C.2 ; 3RD FLOOR-BIRD
 237   820923   15101782   W
 237   820923   15102216   W    38 ITEMS. PRESS RETURN FOR DISPLAY, OR S AND RETURN FOR NEW SEARCH:
 237   820923   15102521   R
 237   820923   15102557   W
 237   820923   15102584   W    37. MCCONNELL-GINET, SALLY *
 237   820923   15102661   W   WOMEN AND LANGUAGE IN LITERATURE AND SOCIETY ; NEW YORK, PRAEGER, 1980
 237   820923   15102778   W  HQ1206.W872 ; 4TH FLOOR-BIRD
 237   820923   15102902   W
 237   820923   15102952   W    38. CRANE, ROBERT I *
 237   820923   15103011   W   LANGUAGE AND SOCIETY IN MODERN INDIA, ESSAYS IN HONOUR OF PROFESSOR ROBERT
 237   820923   15103116   W  O. SWAN ; NEW DELHI, HERITAGE, 1981
 237   820923   15103181   W  UNCATALOGED ; 5TH FLOOR-BIRD
 237   820923   15103242   W
 237   820923   15103278   W  END OF LIST. FOR NEW SEARCH PRESS S AND RETURN:
 237   820923   15103680   R  OFF
 237   820923   15103755   W      9.53 DURATION,   4.52 SEC'S CPU
 237   820923   15104849   W  C237)      WELCOME TO SULIRS
 237   820923   15104947   W       (KEYWORD EXTENDED SEARCH VERSION)
 237   820923   15110236   W
 237   820923   15110435   W  ENTER SEARCH:
 237   820923   15122336   W  OC; 7041499
 237   820923   15122409   W  SEARCHING "7041499"
 237   820923   15122505   W     1 ITEMS. PRESS RETURN FOR DISPLAY, OR S AND RETURN FOR NEW SEARCH:
 237   820923   15122661   R
 237   820923   15122704   W
 237   820923   15122745   W     1. NATIONAL LEAGUE FOR NURSING
 237   820923   15122777   W   NURSING AND HEALTH CARE *
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PORT   DATE     TIME                          MSG TO/FROM USER

 237   820923   15122822   W  WESTPORT, CT, HEALTH SCIENCE DIVISION, TECHNOMIC PUB. CO
 237   820923   15122899   W  RT1.N763 ; SCI & TECH LIB
 237   820923   15123070   W
 237   820923   15123186   W  END OF LIST. FOR NEW SEARCH PRESS S AND RETURN:
 237   820923   15142342   R  S
 237   820923   15142382   W
 237   820923   15142492   W  ENTER SEARCH:
 237   820923   15144085   R  OC; 210614
 237   820923   15144101   W  SEARCHING "210614"
 237   820923   15144209   W  NO ITEMS FOUND FOR THE SEARCH: 210614
 237   820923   15144278   W
 237   820923   15144357   W  ENTER SEARCH:
 238   820923   15005561   W  C238)      WELCOME TO SULIRS
 238   820923   15005968   W       (KEYWORD EXTENDED SEARCH VERSION)
 238   820923   15010144   W
 238   820923   15010186   W  ENTER SEARCH:
 238   820923   15102639   R  WD; WOMEN RELIGION
 238   820923   15102644   W  SEARCHING "WOMEN"
 238   820923   15102754   W  SEARCHING "RELIGION"
 238   820923   15102942   W  STILL SEARCHING
 238   820923   15103170   W  STILL SEARCHING
 238   820923   15103277   W    42 ITEMS. PRESS RETURN FOR DISPLAY, OR S AND RETURN FOR NEW SEARCH:
 238   820923   15104292   R
 238   820923   15104380   W
 238   820923   15104917   W     1. WELCH, GALBRAITH
 238   820923   15110186   W   AFRICA BEFORE THEY CAME
 238   820923   15110431   W  THE CONINENT, NORTH, SOUTH, EAST, WEST, PRECEDING THE COLONIAL POWERS
 238   820923   15110537   W  NEW YORK, MORROW, 1965
 238   820923   15110617   W  DT25.W4 ;  5TH FLOOR-BIRD
 238   820923   15111024   W
 238   820923   15111795   W     2. FLETCHER, JEFFERSON BUTLER, 1865-1946
 238   820923   15111847   W   THE RELIGION OF BEAUTY IN WOMAN, AND OTHER ESSAYS ON PLATONIC LOVE IN POETRY
 238   820923   15112105   W  AND SOCIETY ;  NEW YORK, JASKELL HOUSE, 1966
 238   820923   15112263   W  HQ1111.F5 1966 ;  4TH FLOOR-BIRD
 238   820923   15112382   W
 238   820923   15112416   W     3. YOSHIOKO, BARBARA GERD SAMUELSEN
 238   820923   15112568   W   IMAGINAL WORLDS : WOMAN AND PREACHER IN SEVENTEENTH-CENTURY ENGLAND
 238   820923   15112780   W  ; SYRACUSE, N.Y. SYRACUSE UNIVERSITY, 1977
 238   820923   15112927   W  FILM300 ;
 238   820923   15113376   W
 238   820923   15113720   W     4. AMERICAN ACADEMY OF RELIGION *
 238   820923   15114088   W   WOMEN AND RELIGION: 1973
 238   820923   15114165   W  WATERLOO, ONTARIO, AMERICAN ACADEMY OF RELIGION, 1973
 238   820923   15114268   W  BL458.W6 1973 ; 3RD FLOOR-BIRD
 238   820923   15114369   W
 238   820923   15114399   W
 238   820923   15114424   W    42 ITEMS. PRESS RETURN FOR DISPLAY, OR S AND RETURN FOR NEW SEARCH:
 239   820923   15115224   R
 238   820923   15115286   W
 238   820923   15115443   W     5. SEXIST RELIGION AND WOMEN IN THE CHURCH; NO MORE SILENCE *
 238   820923   15120007   W   NY, ASSOCIATION PRESS, 1974
 238   820923   15120070   W  BL458.W6 1973 ;  3RD FLOOR-BIRD
 238   820923   15120274   W
 238   820923   15120319   W     6. PLASKOW, JUDITH *
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PORT   DATE     TIME                    MSG TO/FROM USER

 238   820923   15120347   W   WOMEN AND RELIGION; PAPERS OF THE WORKING GROUP ON WOMEN AND RELIGION,
 238   820923   15120433   W  1972-1973 ;  CHAMBERSBERG, PA, AMERICAN ACADEMY OF RELIGION, 1974
 238   820923   15120636   W  BL458.P55 1974 ;  3RD FLOOR-BIRD
 238   820923   15120943   W
 238   820923   15121076   W     7. ASHE, GEOFFREY
 238   820923   15121131   W   THE VIRGIN ;  LONDON, ROUTLEDGE & PAUL, 1976
 238   820923   15121346   W  BT645.A85 ;  3RD FLOOR-BIRD
 238   820923   15121467   W
 238   820923   15121496   W     8. FRANTZ, MARIE LUISE VON, 1915- *
 238   820923   15121536   W   PROBLEMS OF THE FEMININE IN FAIRYTALES *
 238   820923   15121615   W  ZURICH, SPRING PUBLICATIONS, NEW YORK, THE ANALYTICAL PSYCHOLOGY CLUB OF NEW
 238   820923   15121615   W  YORK, 1976
 238   820923   15121740   W  GR470.F7 1976 ;  5TH FLOOR-BIRD
 238   820923   15121807   W
 238   820923   15121816   W     9. CLARK,ELIZABETH, 1938- *
 238   820923   15121904   W   WOMEN AND RELIGION : A FEMINIST SOURCEBOOK OF CHRISTIAN THOUGHT
 238   820923   15121971   W  1ST ED, NEW YORK, HARPER, C1977
 238   820923   15122015   W  BT704.C53 1977 ;  3RD FLOOR-BIRD
 238   820923   15122058   W     12 ITEMS. PRESS RETURN FOR DISPLAY, OR S AND RETURN FOR NEW SEARCH:
 238   820923   15122932   R  S
 238   820923   15122944   W
 238   820923   15123069   W  ENTER SEARCH:
 238   820923   15135635   R  WD;CORPUS CHRISTIANORUM
 238   820923   15135660   W  SEARCHING "CORPUS"
 238   820923   15140013   W  SEARCHING "CHRISTIANORUM"
 238   820923   15140409   W     3 ITEMS. PRESS RETURN FOR DISPLAY, OR S AND RETURN FOR NEW SEARCH:
 238   820923   15140811   R
 238   820923   15140923   W
 238   820923   15141144   W     1. CORPUS CHRISTIANORUM : TURNHOLTI, TYPOGRAPHI BREPOLS, 1953-
 238   820923   15141305   W  BR60.C49 ;  3RD FLOOR-BIRD
 238   820923   15141438   W
 238   820923   15141853   W     2. CORPUS CHRISTIANORUM : CONTINUATIO MEDIAEVALIS
 238   820923   15142218   W  TURNHOLTI, TYPOGRAPHI BREPOLS
 238   820923   15142385   W  BR60.C51 ;  3RD FLOOR-BIRD
 238   820923   15142560   W
 238   820923   15142601   W     3. CORPUS CHRISTIANORUM. SERIES LATINA; 85A
 238   820923   15142703   W   TURNHOLT, TYPOGRAPHI BREPOLS EDITORES PONTIFICII, 1979
 238   820923   15142827   W  RECEIVED
 238   820923   15142882   W
 238   820923   15142918   W  END OF LIST. FOR NEW SEARCH PRESS S AND RETURN:
 239   820923   14535920   W  C239)      WELCOME TO SULIRS
 239   280923   14540040   W
 239   820923   14540045   W  ENTER SEARCH:
 239   820923   14540265   R  S
 239   820923   14540266   W
 239   820923   14540281   W  ENTER SEARCH:
 239   820923   14541930   R  TI;EDUCATION
 239   820923   14543965   W  SEARCHING "EDUCATION"
 239   820923   14544058   W  SEARCH WORDS ARE TOO COMMON FOR A COMPLETE SEARCH.
 239   820923   14544111   W  FOR THE FIRST 999 PRESS RETURN, OR S AND RETURN FOR NEW SEARCH:
 239   820923   15003942   R
 239   820923   15003974   W
 239   820923   15003989   W     1. CLARKE, M L
 239   820923   15004045   W   HIGHER EDUCATION IN THE ANCIENT WORLD
```

Appendix C: Listing of SULIRS Transaction Log Analyser Program

```
PROGRAM SULIRS;
(*PROGRAM TITLE: AUTOMATIC ANALYSER FOR SULIRS TRANSACTIONS LOG.
PROGRAMMER: KUMUD MADHOK.
DATE: MAY 3, 1983
PURPOSE: FOR CLR GRANT FEEDBACK AND EXPLORATORY MECHANISMS FOR
          ASSISTING LIBRARY STAFF IMPROVE ON-LINE CATALOG
         SEARCHING*)
(*************************************************************)
VAR L:STRING(132);VAR  DA,D1,D2,TI,T1,T2:STRING(10);
VAR RC:STRING(32767);
   VAR   O,C,S,R,N,DV,PN,RN:INTEGER;
   DATA,PORTS:TEXT;
TYPE PORTARRAY=ARRAY[1..30,1..2] OF INTEGER;
TYPE STOPLIST=ARRAY[1..44] OF INTEGER;
TYPE SRCODES=ARRAY[1..11] OF RECORD
                                CODE:STRING(2);
                                FREQ;INTEGER;TERM;INTEGER
                             END;
VAR PA:PORTARRAY;
   SRC:SRCODES;
  SP:STOPLIST;
(*************************************************************)
PROCEDURE MAKESTOPLIST(VAR SL:STOPLIST);
(*THIS PROCEDURE MAKES A STOPLIST OF THE PORTNUMBERS USED BY THE
LIBRARY STAFF AND LIBRARY PUBLIC. THE STOPLIST IS USED WHEN THE
PROGRAM IS RUN TO COLLECT STATISTICS ON EXTERNAL USERS.*)
VAR LIST1,LIST2:TEXT;
VAR I,L:INTEGER;
VAR N:STRING(10);
BEGIN
N:='LBSTAFF';
RESET(LIST1,'NAME='||N||'.SCRIPT');
FOR I:=1 TO 25 DO
   BEGIN
   READLN(LIST1,L);
   SL[I]:=L
   END;
N:='LBPUBLIC';
RESET(LIST2,'NAME='||N||'.SCRIPT');
FOR I:=26 TO 44 DO
   BEGIN
   READLN(LIST2,L);
   SL[I]:=L
   END
END;
(*************************************************************)
PROCEDURE INITIALISEPORTARRAY(VAR P:PORTARRAY);
(*THE ARRAY CONTAINING ALL THE PORTNUMBERS OF THE SPECIFIED
CATEGORY OF USERS IS INITIALISED HERE.*)
VAR I,J:INTEGER;
```

```
BEGIN
FOR I:=1 TO 30 DO
   FOR J:=1 TO 2 DO
      P[I,J]:=0
END;
(*****************************************************************)
PROCEDURE READRECORDETAIL(VAR PNUM:INTEGER;VAR P1:INTEGER;
                          VAR DATE,TIME:STRING(10));
(*THIS PROCEDURE READS THE PORTNUMBER, DATE AND TIME OF EACH
RECORD*)
VAR RD :STRING(132);
    X,Y,PNODE,PNODE1,PNODE2,PNUM1,PNUM2:INTEGER;
BEGIN
P1:=19;
   RD:=SUBSTR(RC,1,P1-1);
  PNODE1:=ORD(RD[1])-ORD(0);PNODE2:=ORD(RD[2])-ORD(0);
  PNUM1:=ORD(RD[3])-ORD(0);PNUM2:=ORD(RD[4])-ORD(0);
  PNODE:=PNODE1*256+PNODE2;PNUM:=PNUM1*256+PNUM2;
  DATE:=SUBSTR(RD,5,6);TIME:=SUBSTR(RD,11)
END;
(*****************************************************************)
PROCEDURE FILLBPORTS(VAR P:PORTARRAY);
VAR L:STRING(10);VAR N:INTEGER;
BEGIN
    IF O=1 THEN L:='LBSTAFF'
    ELSE L:='LBPUBLIC';
    RESET(PORTS,'NAME='||L||'.SCRIPT');
    RN:=0;
    WHILE NOT EOF(PORTS) DO
         BEGIN
         READLN(PORTS,N);RN:=RN+1;P[RN,1]:=N
         END
END;
(*****************************************************************)
PROCEDURE FILLXTPORTS(VAR PNUM:INTEGER;SL:STOPLIST;
                      VAR P:PORTARRAY);
VAR I,J:INTEGER;
BEGIN
FOR I:=1 TO 44 DO
    BEGIN
    IF PNUM=SL[I] THEN RETURN
    END;
FOR J:=1 TO 30 DO
    BEGIN
    IF PNUM=P[J,1] THEN RETURN
    ELSE
       BEGIN
       IF P[J,1]=0 THEN
            BEGIN
            P[J,1]:=PNUM;RN:=RN+1;
            RETURN
            END
       END
    END
END;
(*****************************************************)
```

```
PROCEDURE COUNTPORT(PNUM:INTEGER;VAR P:PORTARRAY);
(*THIS PROCEDURE COUNTS THE NUMBER OF TIMES EACH PORT IS USED.
THE USE OF A PORT IS DEFINED AS ENTRY OF A SEARCHCODE BY THE
USER*)
VAR  I :INTEGER;
BEGIN
       FOR I:=1 TO RN DO
          BEGIN
          IF PNUM=P[I,1] THEN
             BEGIN
            P[I,2]:=P[I,2]+1;RETURN
             END
          END
END;
(*************************************************************)
PROCEDURE SWITCH(VAR A,B,C,D:INTEGER);
(*THIS PROCEDURE IS USED IN THE SORTING OF THE PORTNUMBERS.*)
VAR X,Y:INTEGER;
BEGIN
IF A>B THEN
   BEGIN
   X:=A;Y:=C;A:=B;C:=D;B:=X;D:=Y
   END
END;
(*************************************************************)
PROCEDURE SORTPORTARRAY(P:PORTARRAY);
(*THIS PROCEDURE SORTS THE PORTNUMBERS, IN ASCENDING ORDER, IN
2 WAYS -- BY THE PORTNUMBERS AND BY THE FREQUENCY OF USE.*)
VAR R:CHAR;
VAR K,I,J:INTEGER;
BEGIN
WRITELN;WRITELN;WRITELN;
IF RN=0 THEN
     BEGIN
     WRITELN('NO USERS IN THIS CATEGORY');RETURN
     END
ELSE
     BEGIN
WRITELN;WRITELN;WRITELN;
WRITELN('SORTED BY PORT NUMBER');
FOR K:=RN-1 DOWNTO 1 DO
   FOR I:=1 TO K DO SWITCH(P[I,1],P[I+1,1],P[I,2],P[I+1,2]);
WRITELN;
WRITELN('PORT NUMBER/USE-FREQUENCY');
FOR J:=1 TO RN DO WRITELN(P[J,1],P[J,2]);
WRITELN;WRITELN;WRITELN;
WRITELN('SORTED BY FREQUENCY');
FOR K:=RN-1 DOWNTO 1 DO
   FOR I:=1 TO K DO SWITCH(P[I,2],P[I+1,2],P[I,1],P[I+1,1]);
WRITELN;
WRITELN('PORT NUMBER/USE-FREQUENCY');
FOR J:=1 TO RN DO WRITELN(P[J,1],P[J,2])
END
END;
(*************************************************************)
PROCEDURE FILLSEARCHCODES(VAR SC:SRCODES);
```

```
(*THIS PROCEDURE BUILDS AN ARRAY OF RECORDS EACH OF WHICH
HAS THE SEARCH-CODE IN ONE FIELD AND ITS USE-FREQUENCY IN
THE OTHER*)
VAR I:INTEGER;
BEGIN
FOR I:=1 TO 11 DO
   SC[I].FREQ:=0;SC[I].TERM:=0;
SC[1].CODE:='AU';SC[2].CODE:='TI';SC[3].CODE:='SB';SC[4].CODE:='WD';
SC[5].CODE:='ST';SC[6].CODE:='CN';SC[7].CODE:='LC';SC[8].CODE:='OC';
SC[9].CODE:='IB';SC[10].CODE:='IS';SC[11].CODE:='AN';
END;
(*************************************************************)
FUNCTION RELEVANTPORT(A,I:INTEGER; B:PORTARRAY):BOOLEAN;
BEGIN
RELEVANTPORT:=(A=B[I,1])
END;
(*************************************************************)
PROCEDURE COUNTSEARCHCODES(P1,PNUM:INTEGER;VAR SC:SRCODES;
                           VAR P:PORTARRAY);
(*THIS PROCEDURE COUNTS THE NUMBER OF TIMES EACH SEARCHCODE IS USED
AND THE NUMBER OF KEY-TERMS USED WITH EACH CODE.*)
VAR MG,WD  :STRING(32767);SWD:STRING(2);
    X,I,J, Y,B:INTEGER;
BEGIN
IF RC[P1]<>'R' THEN RETURN
ELSE
   BEGIN
   FOR J:=1 TO RN DO
     BEGIN
     IF RELEVANTPORT(PNUM,J,P) THEN
       BEGIN
   MG:=SUBSTR(RC,P1);
  X:=INDEX(MG,';');
   IF X<3 THEN RETURN
   ELSE
      BEGIN
      SWD:=SUBSTR(MG,X-2,2);
     FOR I:=1 TO 11 DO
        BEGIN
        IF SWD=SC[I].CODE THEN
           BEGIN
           SC[I].FREQ:=SC[I].FREQ+1;COUNTPORT(PNUM,P);
           LEAVE
           END
        END;
      MG:=SUBSTR(MG,X+1);
      MG:=COMPRESS(TRIM(LTRIM(MG)));
      MG:=MG||' ';
      B:=INDEX(MG,' ');
      REPEAT
         BEGIN
         WD:=SUBSTR(MG,1,B);
         Y:=INDEX(WD,';');
        IF Y=0 THEN SC[I].TERM:=SC[I].TERM+1
        ELSE
           BEGIN
```

```
            IF (Y)>=3 THEN
               BEGIN
            SWD:=SUBSTR(WD,Y-2,2);
            FOR I:=1 TO 11 DO
               BEGIN
               IF SWD=SC[I].CODE THEN
                  BEGIN
                SC[I].FREQ:=SC[I].FREQ+1;
                LEAVE
                END
              END;
          IF (B-Y)>1 THEN SC[I].TERM:=SC[I].TERM+1
         END
       END;
          MG:=SUBSTR(MG,B+1);
          B:=INDEX(MG,' ');
          IF MG=' ' THEN LEAVE
          END;
       UNTIL FALSE
       END;
    RETURN
     END
  END
  END
END;
(*************************************************************)
PROCEDURE PRINTSEARCHCODES(SC:SRCODES);
(*THIS PROCEDURE PRINTS THE SEARCH-CODES,
THEIR CORRESPONDING USE-FREQUENCIES, AND
THE NUMBER OF TERMS USED WITH EACH SEARCH-CODE*)
VAR I:INTEGER;VAR A:REAL;
BEGIN
WRITELN;WRITELN;WRITELN;
WRITELN('SEARCH-CODE/USE-FREQ/AVG TERM-NUM');
FOR I:=1 TO 11 DO
    BEGIN
   IF SC[I].FREQ=0 THEN A:=0
   ELSE A:=SC[I].TERM/SC[I].FREQ;
   WRITELN(SC[I].CODE,SC[I].FREQ,A:10:3)
   END
END;
(*************************************************************)
(*THIS IS THE MAIN PROGRAM*)
BEGIN
TERMIN(INPUT);TERMOUT(OUTPUT);
WRITELN('PROGRAM TITLE: AUTOMATIC ANALYSER FOR SULIRS TRANSACTIONS');
WRITELN('                LOG.');
WRITELN('PROGRAMMER: KUMUD MADHOK');
WRITELN('DATE: MAY 3, 1983');
WRITELN('PURPOSE: FOR CLR GRANT "FEEDBACK AND EXPLORATORY MECHANISMS');
WRITELN('         FOR ASSISTING LIBRARY STAFF IMPROVE ON-LINE CATALOG');
WRITELN('         SEARCHING"');
WRITELN;WRITELN;WRITELN;
WRITELN('TYPE INPUT FILE NAME');
READLN(L);
RESET(DATA,'DDNAME='||L);
```

```
WRITELN;WRITELN;WRITELN;
WRITELN('HOW MANY RECORDS TO SKIP? TYPE ONLY NUMBERS');
READLN(S);WRITELN;
WRITELN('HOW MANY RECORDS TO PROCESS? TYPE ONLY NUMBERS');
READLN(R);WRITELN;
WRITELN;WRITELN('TYPE IN DESIRED OPTION NUMBER');
WRITELN('YOU HAVE 3 OPTIONS:   1)LBSTAFF');
WRITELN('                      2)LBPUBLIC');
WRITELN('                      3)EXTERNAL');
READLN(O);
IF O=3 THEN MAKESTOPLIST(SP);
INITIALISEPORTARRAY(PA);
IF (O=1) OR (O=2) THEN FILLBPORTS(PA);
FILLSEARCHCODES(SRC);
RESET(DATA);
READLN(DATA,RC);
READRECORDETAIL(PN,DV,DA,TI);
D1:=DA;T1:=TI;
RESET(DATA);
IF S>0 THEN
   FOR N:=1 TO S DO READLN(DATA,RC);
C:=0;
FOR N:=S+1 TO S+R DO
      BEGIN
      IF (EOF(DATA)) OR (C=R) THEN
           BEGIN
           D2:=DA;T2:=TI
           END
      ELSE
           BEGIN
           READLN(DATA,RC);
           READRECORDETAIL(PN,DV,DA,TI);
           IF O=3 THEN FILLXTPORTS(PN,SP,PA);
           COUNTSEARCHCODES(DV,PN,SRC,PA);
           C:=C+1;
           IF (C MOD 500)=0 THEN WRITELN(S+C,'TH RECORD READ')
           END;
     IF C=R THEN
           BEGIN
           D2:=DA;T2:=TI
           END
     END;
SORTPORTARRAY(PA);
PRINTSEARCHCODES(SRC);
WRITELN;WRITELN;WRITELN;
WRITELN('TOTAL NUMBER OF RECORDS IN DATA FILE IS',C); WRITELN;
WRITELN('TIME RANGE IS FROM ',T1,' ON ',D1,' TO ',T2,' ON ',D2);
WRITELN;WRITELN;WRITELN;WRITELN
END.
```

(End of listing)